AirLink ES440

Hardware User Guide

4114607
Rev 1

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Consult our website for up-to-date product descriptions, documentation, application notes, firmware upgrades, troubleshooting tips, and press releases:

www.sierrawireless.com

Contents

Introduction to the AirLink ES440 7

Introduction. 7

Out-of-Band Management (OOBM) 8

Network Configuration 9

Description 9

Front Panel 9

Rear Panel 10

ALEOS Software 11

ACEmanager 12

AirVantage Management Service 12

Accessories 13

Ordering Information 13

Warranty. 13

Startup and Configuration 15

Initial Startup and Configuration. 15

Tools and Materials Required 15

Installing the SIM Card 15

Connecting the Antennas 17

Connecting the Configuration PC 17

Connecting the Enterprise Router 18

Starting the ES440 19

LED Operation 21

Configuring with ACEmanager. 23

Configuring with AirVantage Management Service 24

Configuring with AT Commands. 25

On-site Installation and Setup 27

Typical Configuration 27

Locating the ES440 28

Mounting the ES440 28
Antenna Installation 29
Antenna Separation Recommendations 30
Connecting the Enterprise Router 31
Local Management 31
Remote Management 31
Antenna Recommendations 32

AirLink ES440 Specifications 33
Environmental 34
Mechanical Specifications 36
Regulatory Standards 36

Regulatory Information 39
Federal Communications Commission Notice (FCC United States) 39
Notice for Canadian Users 39
Important Information for North American Users on Radiation Exposure 40
Europe Generic Devices 41

Index. 47

1: Introduction to the AirLink ES440

This chapter describes the Sierra Wireless AirLink ES440, including a description of ALEOS™ embedded software and the AirVantage Management Service (AVMS) device management platform.

Introduction

The Sierra Wireless ES440 enterprise gateway delivers mission-critical 4G LTE connectivity when primary landline connections are unavailable. When deployed with an enterprise router, the ES440 supports a best-in-class business continuity strategy by enabling out-of-band management (OOBM) capability to network operations while leveraging the router's instant failover, routing, and firewall features.

You can also configure the ES440 to send its management data via the DSL/cable gateway using reliable static route protocol to reduce wireless network costs.

Additional benefits to this enterprise-class business continuity solution include:

- Improved Internet uptime to keep your branches, kiosks, and retail operations online
- Seamless failover for continuous uptime of mission critical applications
- High speed LTE network, faster than xDSL
- Reduced field visits for network equipment resets and updates
- ALEOS and ACEmanager web-based configuration that makes it quick to deploy
- AirVantage Management Service cloud-based device management application that works in parallel with your network management systems to manage the wireless system
- ALEOS reliable connection software ensures that the ES440 stays connected to the wireless network
- Better SLAs (Service Level Agreements) offers from the Network Operation Centers as a result of the wireless backup offered by the ES440

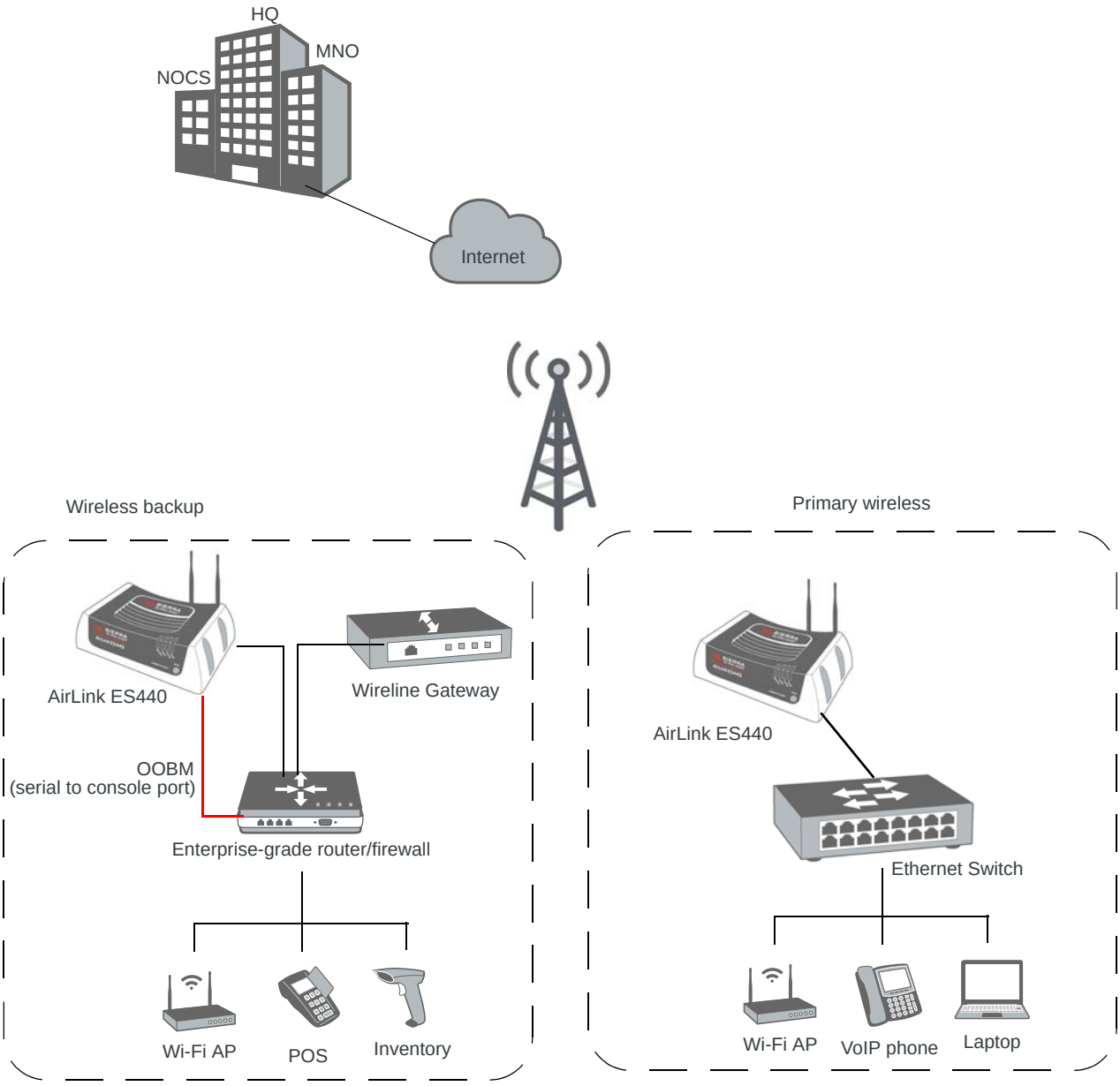


Figure 1-1: AirLink ES440 applications

Out-of-Band Management (OOBM)

Using ES440's serial port to connect to the console port of the router, IT administrators can troubleshoot and repair network equipment over wireless wide area networks (WAN). This terminal server capability allows operation centers to remotely reboot, configure, and update the BIOS of a router via the ES440 enterprise gateway using Reverse Telnet and SSH protocols. As a result, remote personnel no longer need to manually reset their networking equipment and IT administrators can dramatically reduce the number of field visits.

Network Configuration

The ES440 is designed for the distributed enterprise, which includes any enterprise that has remote facilities that must maintain a network connection for critical business processes such as retail credit card transactions.

If you are using the ES440 for a point of sales application, you can configure the ES440 to meet PCI Data Security Standard compliance requirements. ALEOS features such as Reverse Telnet and Reliable Static Routing also support point-of-sale applications. Refer to the ALEOS Configuration User Guide for details.

Description

Front Panel

The front panel has the following indicators and controls:

Figure 1-2: ES440 Front Panel

- **LEDs** – These show the ES440's operating status. Each LED can be red, green, yellow or off. The LEDs are described in detail in LED Operation on page 21. They are:
  - **Network** – When green the ES440 is connected to a cellular network with an IP address assigned and a channel acquired
  - **Signal** – When green it is receiving a cellular signal
  - **Activity** – When green, the radio link is active
  - **Power** – When green, the ES440 is connected to power
- **Reset Button** – Pressing this button resets the ES440. All the LEDs turn solid red after this button is pushed.

Note: Holding the button down for 30–45 seconds resets the ES440 to its default settings.

Rear Panel

The rear panel has the following connectors and controls:

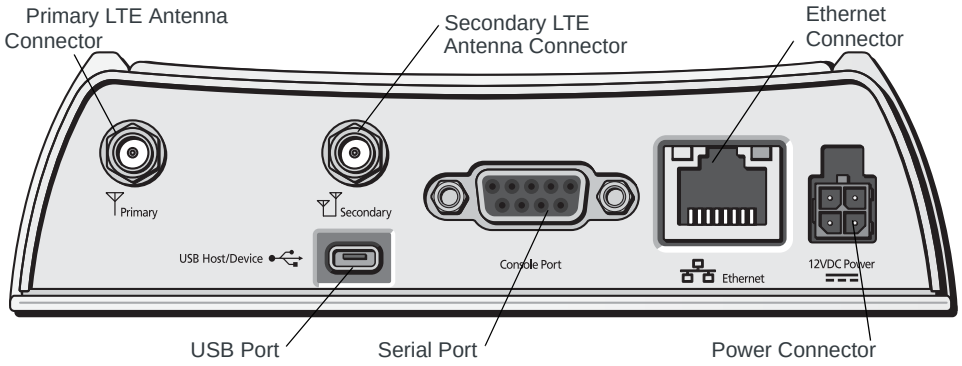


Figure 1-3: ES440 Rear Panel

- **Primary LTE Antenna Connector** – This is the radio's receive and transmit port. For best results, use the included antennas, placed in a V formation. You can attach the antennas directly to the ES440, or you can use a bracket and SMA coax cable to connect antennas located away from the ES440.
- **Secondary LTE Antenna Connector –** This is required for LTE MIMO (multiple-input and multiple-output).

Note: For more information, see Antenna Installation on page 29.

- **Ethernet Connector** – This RJ-45 connector connects any Ethernet-enabled network equipment to the ES440 using a standard Ethernet cable. This is also used to connect a PC to the ES440 for configuration and monitoring, using ACEmanager, the ES440's web-based management utility.

  This connector complies with the IEEE 802.3 specification for 100 Mbps speed (Fast Ethernet) with fallback to 10 Mbps and includes auto-crossover support. It is auto-sensing and auto-detects the speed of the connecting device for 100 baseT or 10 baseT.

  The connector has two LEDs that indicate speed and activity. For more information, see Ethernet LEDs on page 22.
- **Power Connector** – Connect the AC adapter.

  The ES440 automatically starts when power is supplied.
- **Serial Port** – This 9-pin connector provides standard RS-232 DCE communication. For out of band management, you can connect this serial port to an enterprise router. You can also connect a computer to the serial port to configure the ES440 using AT commands.
- **USB Port** – The ES440 has a Micro AB connector that complies with version 2.0 of the USB standard for high-speed operation. It accepts Micro A and Micro B plugs. You can connect a Windows PC to it to monitor and configure the ES440.

  When connected to a PC, it becomes either a:

- Virtual serial port (The ES440 behaves as if the PC is connected to a standard serial port. The primary use if this interface is to send AT commands.)
- Virtual Ethernet port (The ES440 behaves as if the PC is connected to an Ethernet port, allowing access to the Internet and ACEmanager. This is the default setting.)

Refer to the ALEOS Software Configuration User Guide for information on configuring the USB port. Windows drivers for the USB port are available at Sierra Wireless's download web site www.sierrawireless.com/en/Support/Downloads.aspx.

When using the USB port:

- Use a USB 2.0 cable
- Connect directly to your computer for best throughput

ALEOS Software

Note: For detailed information on all of the features in ALEOS, see the ALEOS Configuration User Guide. It is available for downloading from the Sierra Wireless web site.

ALEOS, the embedded core technology of the AirLink product line provides:

- An always-on, always-aware, intelligent two-way connection for mission-critical applications
- Simplified setup, operation and maintenance of any wireless solution

ALEOS enables:

- Reverse Telnet for out of band management
- Reliable Static Routing
- SNMP
- Persistent Network Connectivity
- Over-The-Air (OTA) Upgrades
- Wireless Optimized TCP/IP
- Real-Time Notification
- Packet Level Diagnostics
- Device Management & Control

Sierra Wireless has two tools for monitoring and configuring the ES440. They are:

- **ACEmanager** – A web-based configuration tool for configuring a single AirLink device
- **AirVantage Management Service (AVMS)** – A cloud based device management service for monitoring and configuring fleets of ES440s.

Contact your dealer or Sierra Wireless representative for more information.

Download the applications and user guides from the Sierra Wireless AirLink Solutions web site at www.sierrawireless.com/support.

ACEmanager

ACEmanager is a web-based configuration tool used to set all the ALEOS parameters. ACEmanager:

- Simplifies deployment
- Provides extensive monitoring, control and management capabilities
- Configures your ES440 to meet your needs
- Monitors and controls your AirLink ES440 remotely and in real-time
- Is accessed through a web browser connected to the ES440 locally or OTA

See Configuring with ACEmanager on page 23 to learn how to access ACEmanager.

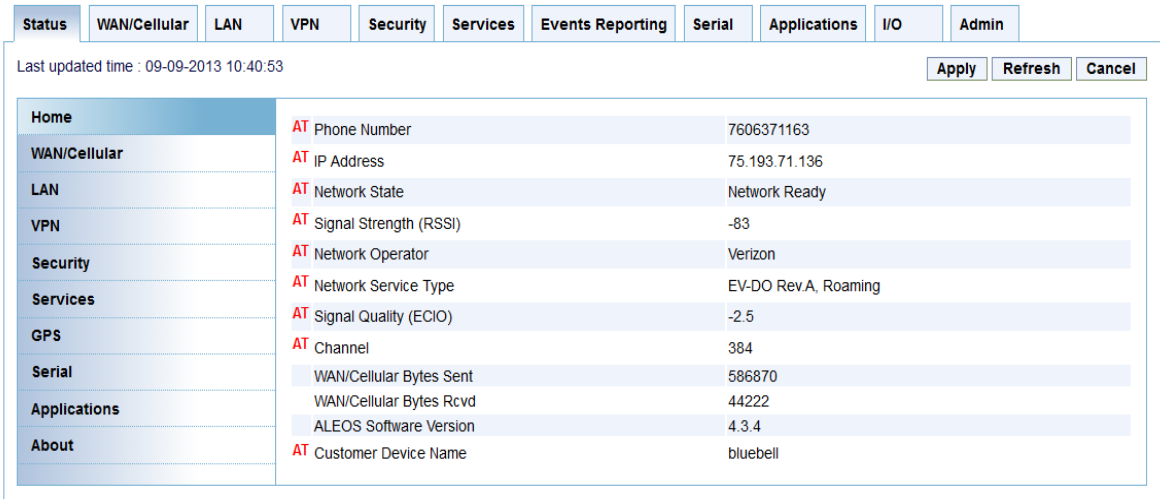


Figure 1-4: ACEmanager Home Page

AirVantage Management Service

The ES440 can be managed with the AirVantage Management Service (AVMS) available from Sierra Wireless. AVMS is a cloud-based application, accessed from your web browser, that provides remote monitoring and configuration for any number of AirLink ALEOS devices from a single computer.

AVMS features include:

- Device management as a service
- Advanced monitoring dashboards and alert notifications ensuring you always know the status of your ES440
- Detailed configuration of all ALEOS parameters, including templates providing batch updates of pre-set configurations across multiple devices
- Over-the-air (OTA) firmware upgrades for all of your ES440s with a single operation

For more information about AVMS, go to www.sierrawireless.com/en/productsandservices/AirVantage/Management_Service.aspx.

To request an account, go to www.sierrawireless.com/Register_AVMS_Trial.

To connect with AVMS, see Configuring with AirVantage Management Service on page 24.

Accessories

- Included with the ES440:
  - 2 LTE antennas
  - AC power adapter, 100–240 VAC, 500mA output
  - AC power adapter options for North and South America, Great Britain, Europe, Australian and New Zealand
- Order separately:
  - Ethernet cable
  - DB-9 serial cable (6 ft and 25 ft lengths)
  - USB cable
  - Null modem cable

Ordering Information

All orders can be made by contacting the Sierra Wireless Sales Desk at +1 (604) 232-1488 between 8am and 5pm Pacific time.

Warranty

The ES440 has a 1-year standard warranty.

2: Startup and Configuration

This chapter shows you how to do the initial device configuration. It also describes the front panel LEDs.

Initial Startup and Configuration

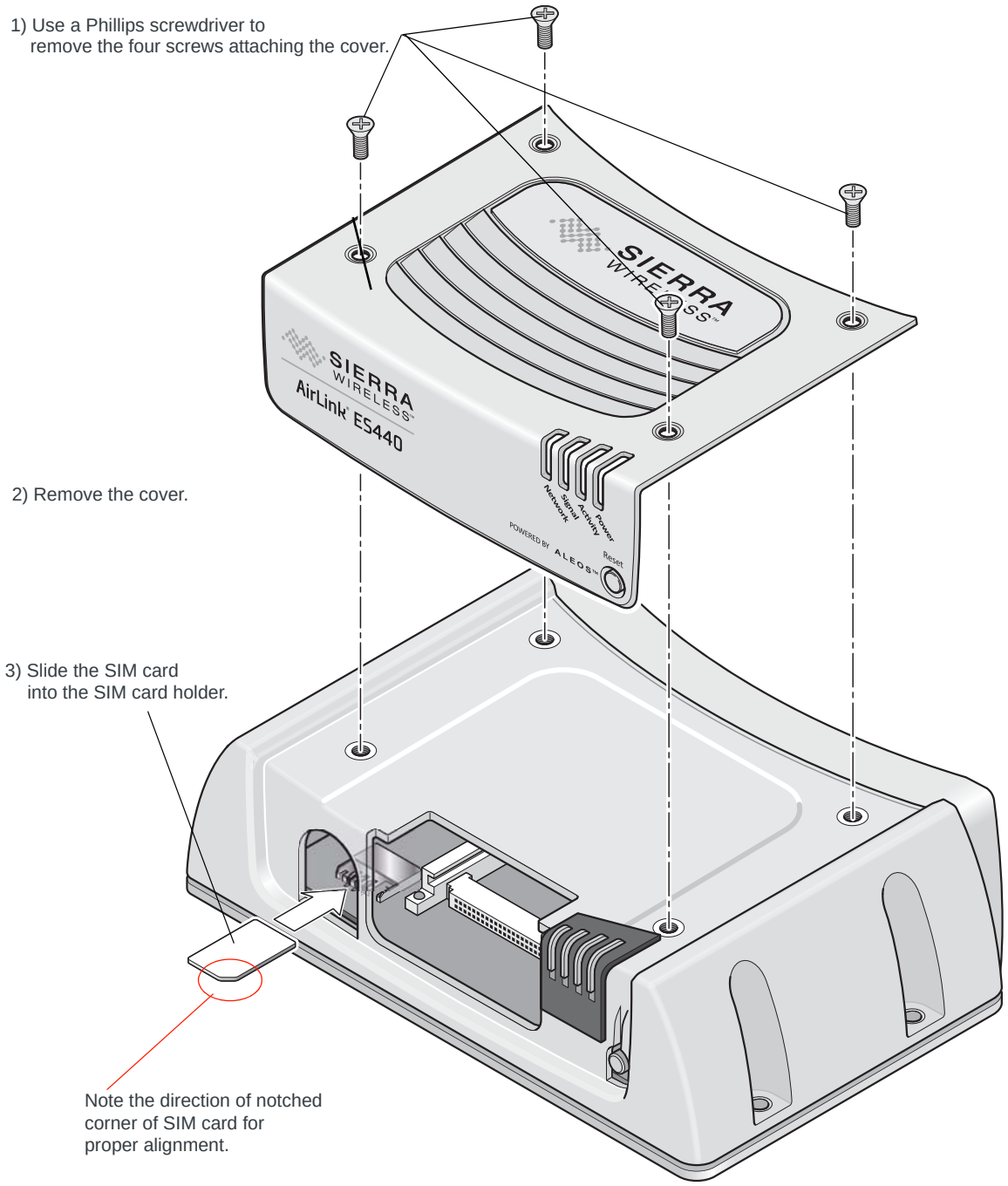
Follow the instructions in this section to do the initial startup and configuration for the ES440. For on-site installation and setup instructions, see On-site Installation and Setup on page 27.

Tools and Materials Required

- A SIM card for your ES440, as provided by your mobile network operator
- A Phillips screwdriver for removing the top cover
- A laptop computer with an Ethernet cable, USB, or serial cable for device management
- 2 LTE wireless antennas (included). For indoor use only.
- AC power adapter (included)
- If wireless out of band management is required, a null modem cable to go from the ES440 RS-232 port to the enterprise router.
- If you are mounting the antennas remotely from the ES440, you will need a coaxial cable, mounting brackets, and connectors. (For more information, see Antenna Installation on page 29.

Installing the SIM Card

If it is not already installed, insert a SIM card into the ES440 before installation or connecting any external equipment or power to the ES440.


1) Use a Phillips screwdriver to remove the four screws attaching the cover.
2) Remove the cover.
3) Slide the SIM card into the SIM card holder.
Note the direction of notched corner of SIM card for proper alignment.
SIERRA WIRELESS
AirLink ES440
Network
Signal
Activity
Power
Reset
POWERED BY ALEOS

4) Reattach the cover. ensuring that the Phillips screws are tightened to 5 in-lb (finger tight, not hand tight) using a screwdriver. Over-tightening can damage the threats in the aluminum housing.

Figure 2-1: SIM Card Installation

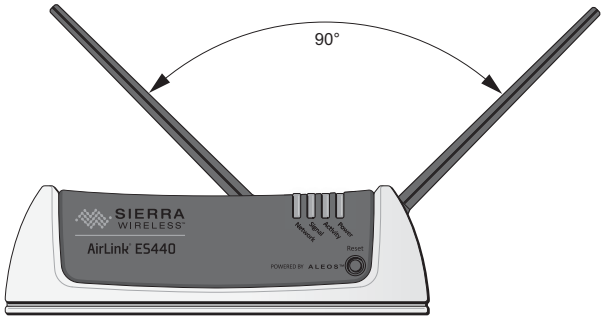
Connecting the Antennas

You can attach the provided LTE antennas directly to the ES440. They operate well when the antenna fans are placed in a V (or rabbit ear) position, with 90 degrees of separation. However, if the area where you want to place the ES440 (such as near an enterprise router) does not have optimal signal coverage or is near RF noise interference, you can place the antennas remotely using brackets, and connect them to the ES440 using a coaxial cable. An RF site survey may be required to determine the best location. See Antenna Installation on page 29.

To connect the antennas:

1. Connect both LTE antennas, placing your fingers on the knurled nut, as shown in the illustration.

2. Adjust the antennas so they are in a V-formation, with a separation of 90 degrees.



Connecting the Configuration PC

There are 3 local management ports on the ES440 for the configuring PC to connect to: Ethernet, USB, and serial. You can configure the USB port as a virtual Ethernet port or a virtual serial port.

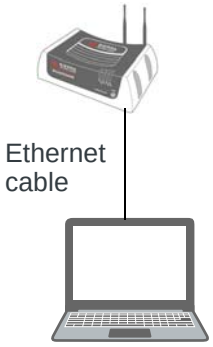
For the initial startup and configuration, you can either:

- Connect the PC to the ES440 Ethernet port.

  or

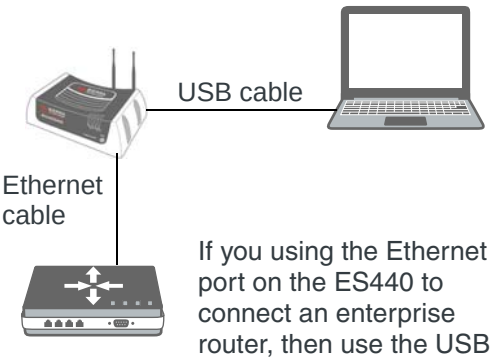
- Connect the PC to the USB port.

Ethernet Connection



If you are not using the Ethernet port on the ES440 to connect an enterprise router, the easiest way to connect the PC is to use an Ethernet cable.

Virtual Ethernet Connection with USB cable



If you using the Ethernet port on the ES440 to connect an enterprise router, then use the USB port to connect the PC and configure it to be a virtual Ethernet port.

To physically connect the computer to the ES440:

1. If you are using a USB cable:
   a. Download the USB drivers from www.sierrawireless.com/Support/Downloads.aspx.
   b. Install the USB drivers.
   c. Reboot the PC.
2. Use the appropriate cable (Ethernet or USB) to connect the PC to the ES440.

Connecting the Enterprise Router

You can connect the AirLink ES440's 9-pin serial connector directly to most computers by using a standard straight-through cable. It is used for device configuration and debugging. When connecting to other network equipment, such as an enterprise router, a null modem cable is required.

This connector complies with the EIA RS-232D specification for DCE equipment. The output driver levels swing from -7VDC to +7VDC with normal loading.

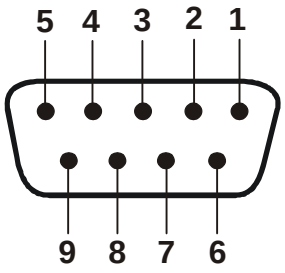
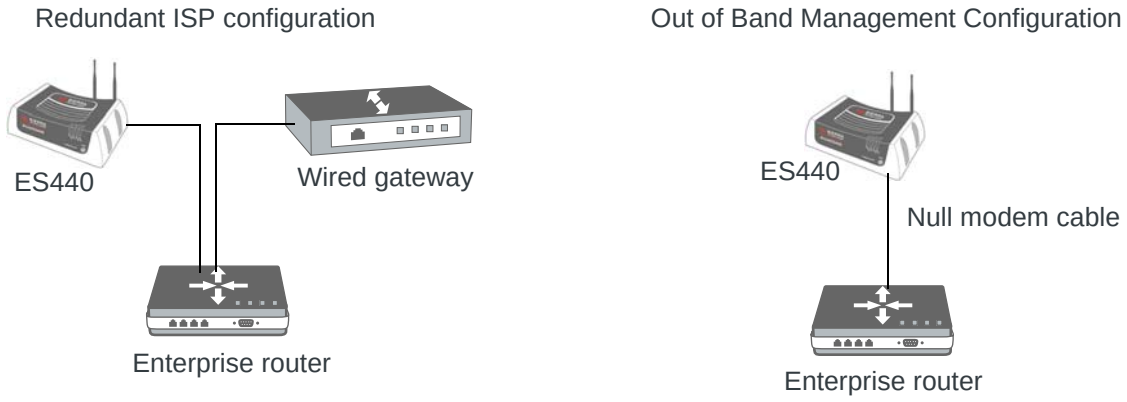


Figure 2-2: 9-Pin Serial Connector Diagram

Table 2-1: Serial Connector Pin-out

Name	Pin	Description	Type
DCD	1	Data Carrier Detect	OUT
TXD	2	Transmit Data	OUT
RXD	3	Receive Data	IN
DTR	4	Data Terminal Ready	IN
GND	5	Main GND. Connected internally to BOARD_GND	GND
DSR	6	Data Set Ready	OUT
RTS	7	Ready To Send	IN
CTS	8	Clear To Send	OUT
RI	9	Ring Indicator	OUT

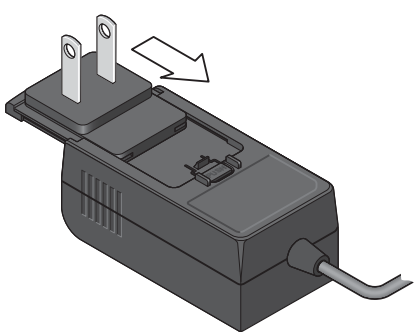


1. Use a serial cable to connect one of the WAN ports on the enterprise router to the RS232 serial connector on the ES440.

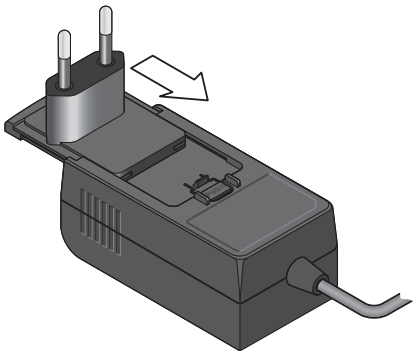
Note: The ES440 is a DCE serial device. The enterprise router may have an RJ45 or DB9 console port. Depending on the type of console port connectors and the cable available from the enterprise router vendor, you may need to purchase additional cables, including a null modem cable from the enterprise router vendor.

Starting the ES440

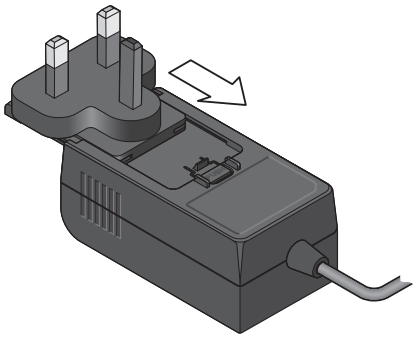
1. Choose the correct AC adapter plug for your region and slide it into the AC adapter base.



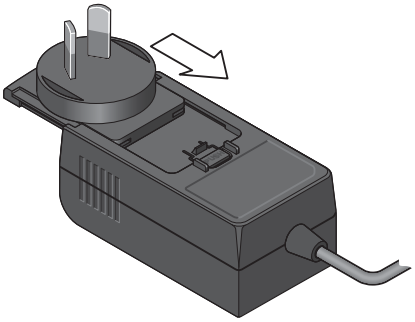
North America



Europe



UK



Australia

2. Connect the power cable to the 4-pin power connector on the ES440.
3. Plug the adapter into an AC wall outlet.

   Characteristics of the ES440 power supply:
   - 100–240V
   - 50/60 Hz.
   - 12V, 1500mA output
4. The ES440 starts automatically, as shown by the flashing LEDs. See LED Operation on page 21 for details. After the initial power up, connect the laptop to the ES440, and open a web browser.
5. In the browser's address bar, enter the IP address: **http://192.168.13.31:9191**.

Note: It may take a minute or two for the ES440 to respond after the first power up.

   The ACEmanager login screen appears.
6. The default user name, user, is already entered. Enter the default password. (**12345)**.

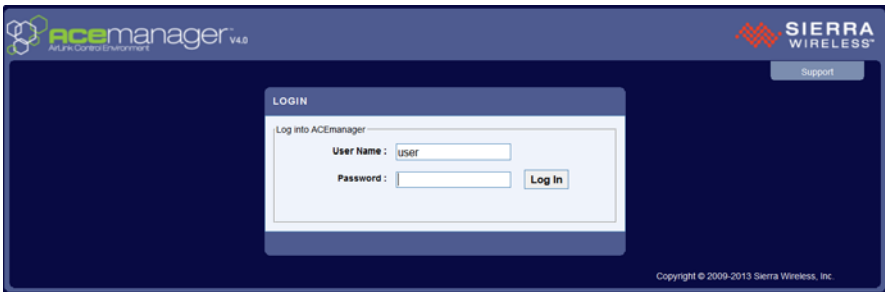


Figure 2-3: ACEmanager Login Screen

The ACEmanager homepage appears.

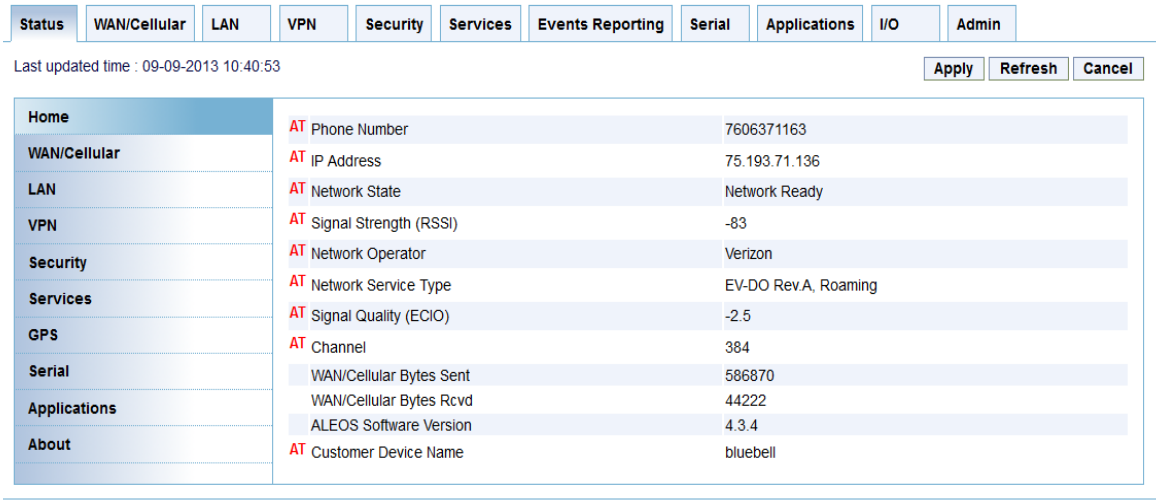


Figure 2-4: ACEmanager Homepage

LED Operation

When on, each LED can be:

- Red
- Green
- Yellow

When on, each LED can be:

- Solid on
- Flashing

The LEDs may be viewed from the top or front.

After the reset button is pushed, all the LEDs are solid red.

Table 2-2: LED Operation

Color	Network LED	Signal LED	Activity LED	Power LED
Off	—	—	Normal operation	No power or input voltage ≥ 36VDC or ≤ 9VDC
Solid Green	Network Ready	Good signal (RSSI ≥ -85 dBm)	—	ES440 is connected to nominal power and is operating normally
Flashing Green (1.0 sec. on / 0.5 sec. off)	Network Ready—Roaming	—	Radio is transmitting or receiving	—
Flashing: Yellow (0.5 sec.) / Green (0.5 sec.) / Off (0.5 sec.)	Network Ready—Roaming (No LTE service)	—	—	—
Flashing Yellow (0.8 sec. on / 0.8 sec. off)	No Service	—	—	—
Solid Yellow	Connecting to the network	Marginal signal (-100 dBm < RSSI < -85 dBm)	—	ES440 entering low power mode or system low level boot
Flashing Red (0.7 s on / 2.3 s. off)	Authentication/Negotiation failed	No signal (RSSI ≤ -110 dBm)	—	—
Solid Red	Link Down No cellular network is present or the ES440 is in radio passthru mode	Poor signal (-110 dBm < RSSI < -100 dBm)	—	ES440 not operational (failure or in low power mode)

Ethernet LEDs

There are four LEDs on the front panel, labeled:

- Network
- Signal
- Activity
- Power

The Ethernet port has two LEDs that indicate speed and activity. When looking into the connector:

- Activity—The right LED is solid yellow when a link is detected (the cable is plugged in) and blinks when there is activity.
- Connection Speed—The left LED is green to indicate a 100 Mbps connection and orange to indicate a 10 Mbps connection. It is off when no cable is connected.

Power-up and Reboot

On power-up or reboot, the LEDs go through a booting sequence. When the boot is complete, the Power and Network LEDs should be green, signifying that the power is on, the ES440 is connected to the wireless network, and there is a good signal. See Table 2-2 for detailed LED operation.

To reboot the ES440:

- In ACEmanager, click the Reboot button at the top right of the screen.

Or

- Press and release the Reset button on the ES440 (see Front Panel on page 9).

Configuring with ACEmanager

The ES440 is highly configurable using ACEmanager, a free ALEOS utility. For all of the configurable features available in ALEOS, see the ALEOS Software Configuration User Guide. It is available for downloading from the Sierra Wireless support web site.

If the ES440 is not connected to the Mobile Network Operator:

1. In ACEmanager, check the Network State on Home page. It should say “Network Ready”. If it says No SIM or Unexpected SIM, check that the correct SIM card is inserted. (See Installing the SIM Card on page 15.
2. Also check the Signal Strength. It should be greater than -100.

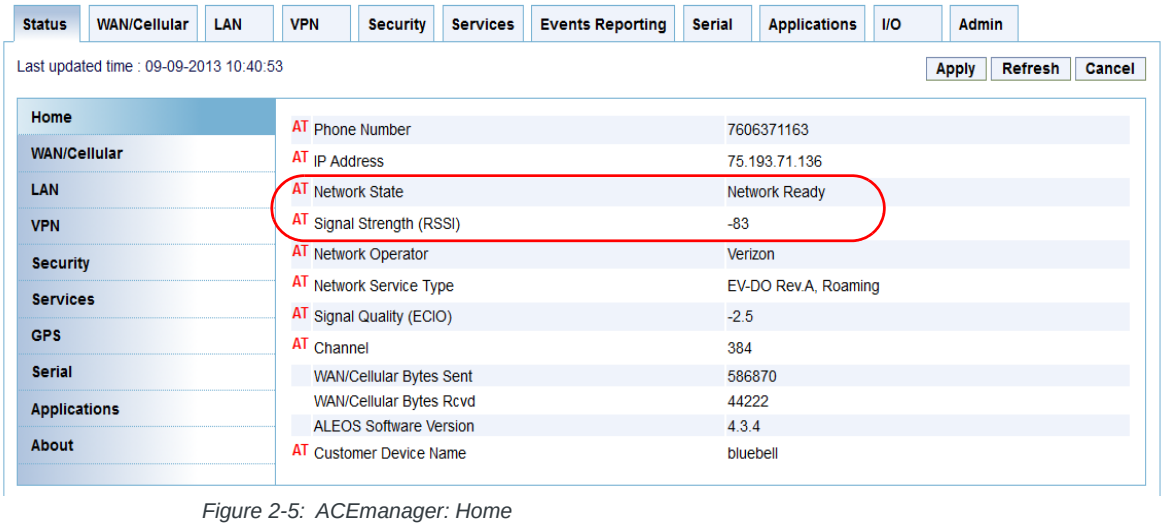


Figure 2-5: ACEmanager: Home

3. Check the APN on the WAN/Cellular tab.

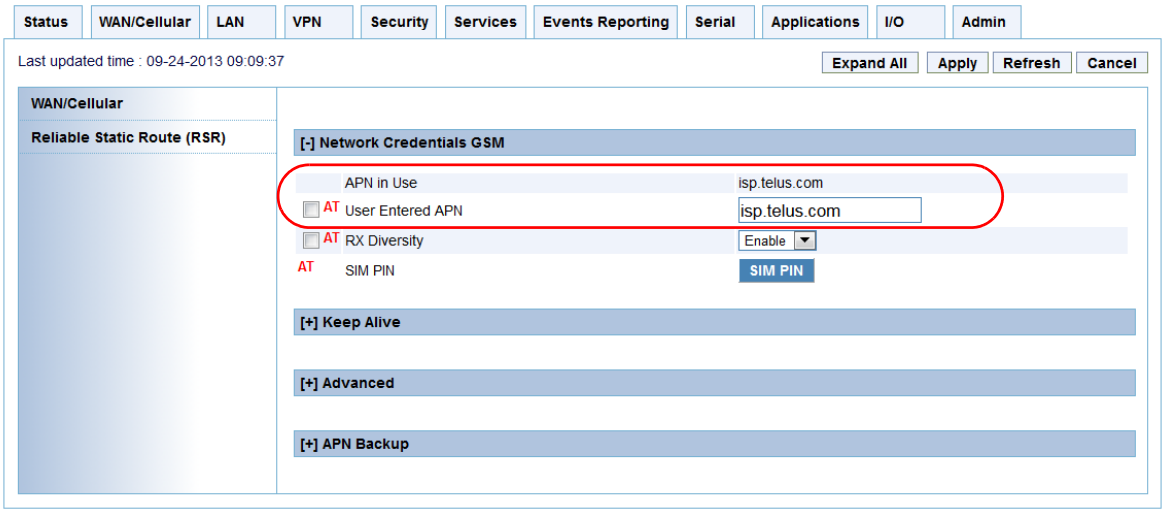


Figure 2-6: ACEmanager: WAN/Cellular

4. If there is still no connection, refer to the ALEOS Software Configuration User Guide.

After the ES440 is connected and configured, you can save the configuration as a template to the configuration PC and then apply this XML template to subsequent ES440s, once they are logged in to ACEmanager or AVMS. Refer to the ALEOS Software Configuration User Guide for details.

Configuring with AirVantage Management Service

the ES440 can be configured with the AirVantage Management Service (AVMS) from Sierra Wireless. AVMS is a cloud-based service that provides remote monitoring and configuration for any number of your AirLink ALEOS devices.

For more information on AVMS, go to www.sierrawireless.com/en/productsandservices/AirVantage/Management_Service.aspx.

To sign up for a free trial account, go to http://na.airvantage.net.

To access AirVantage Management Service:

1. Connect a laptop to the ES440 with an Ethernet cable.
2. Log in to ACEmanager.
3. Go to the Services tab and ensure that AVMS is enabled and the server URL is http://na.m2mop.net/msci/com. If this is not the case, enter the correct URL, click Apply and then click Reboot.
4. In your browser, go to http://na.airvantage.net/start and log in.
5. Follow the instructions in the online AVMS documentation to register your device.

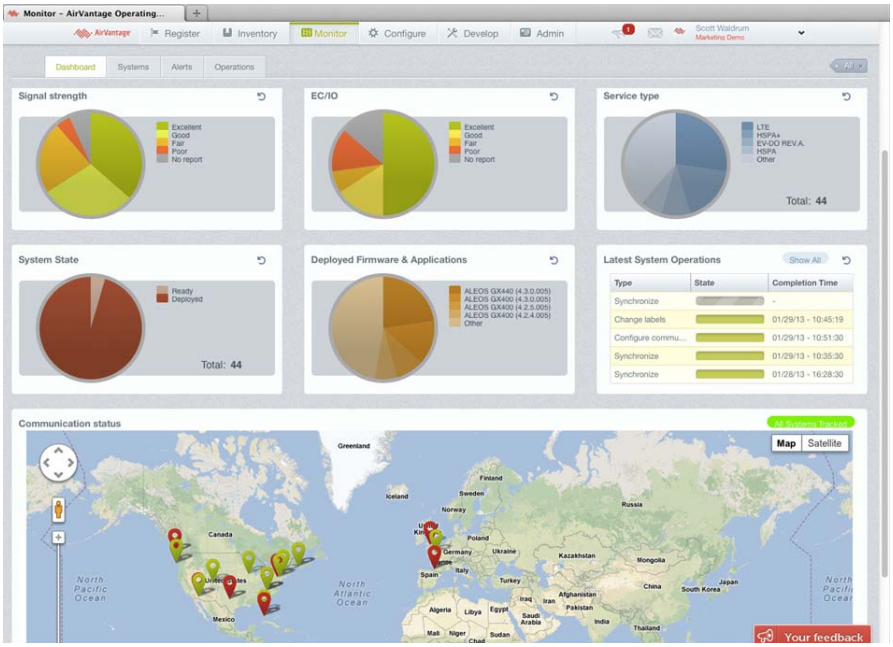


Figure 2-7: AirVantage Management Service window

Configuring with AT Commands

The ES440 can be commanded and configured with AT commands, using the RS232 serial port or the USB port (configured as a virtual serial port). All the commands are listed in the ALEOS Configuration User Guide.

In ACEmanager, mouse over a red AT to the left of a listing to see a popup showing the AT command for that item.

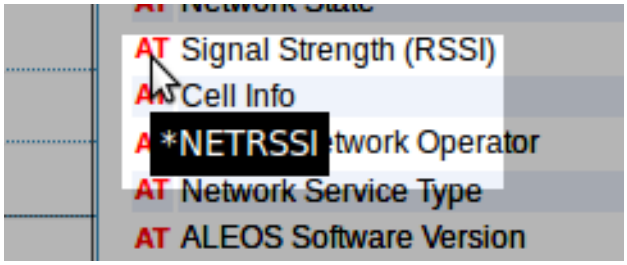


Figure 2-8: Mouse over for AT command (Signal Strength Shown)

- Most AT commands are prefaced with AT. Exceptions are noted in the ALEOS Configuration User Guide.
- The acceptable format and parameters are listed with each command in the ALEOS Configuration User Guide.
- If you enter a recognized AT command, the ES440 responds with “OK.” If the command is wrong, the ES440 responds with “ERROR” or “Unsupported.”

Reset to factory default settings

To reset the ES440 to the factory default settings:

1. Press and hold the Reset button until all the LEDs start flashing yellow (about 30–45 seconds). See Front Panel on page 9.

   The ES440 reboots. Once the reboot is complete and the LEDs resume their normal operating behavior, the reset is complete.

3: On-site Installation and Setup

This chapter shows you how to communicate with and configure the Sierra Wireless AirLink ES440.

Typical Configuration

The ES440 is a purpose built 4G LTE Gateway and Terminal Server. When deployed with an enterprise router, ES440 supports best in class business continuity strategy by enabling out of band management (OOBM) capability to network operations, while leveraging the router's instant failover, routing, and firewall features.

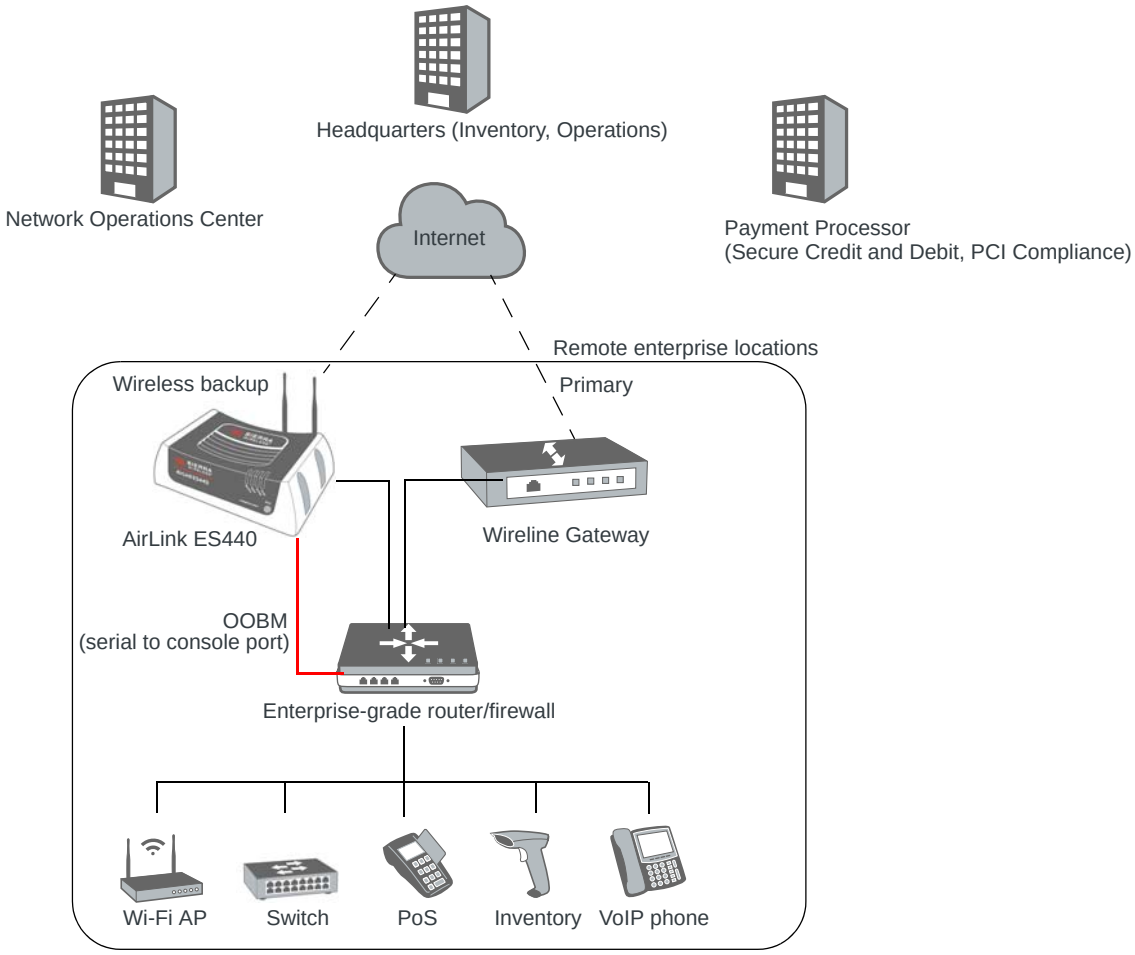


Figure 3-1: Network for Distributed Enterprise Business Continuity Model

Figure 3-1 shows the typical connections to the ES440:

- An Ethernet connection to the enterprise router WAN port for failover with a wireline gateway.

- A serial connection to the enterprise router console port for out of band management
- A USB connection to the local management PC
- A wireless WAN connection to the Mobile Network Operator

The enterprise router performs the ISP failover by monitoring service on the WAN ports. The ES440 is always attached to the MNO network and when the enterprise router sends traffic through the ES440, it will pass through the MNO infrastructure to the enterprise systems, as shown.

If the remote site equipment needs attention, the OOBM feature of the ES440 allows the NOC or IT administrator to perform OOBM tasks on the connected equipment using the ES440 Reverse Telnet/SSH feature. This reduces the number of on-site trips and allows you to remotely manage connected equipment.

If the MNO offers better rates for minimal data usage, you can configure the ES440 to reduce data transfer over the WWAN connection using the Reliable Static Route (RSR) feature to route data sourced from the ES440 through the enterprise router primary connection. Refer to the ALEOS Software Configuration User Guide for information on configuring and using Reverse Telnet/SSH and RSR.

Locating the ES440

Choosing where to place the ES440 and the antennas to get the best performance can be a difficult task. The goal is to locate the ES440 where it can connect to the enterprise router, have good signal coverage, and be in a low RF noise area. The options are:

- Place the ES440, with the antennas connected directly to it in an area with good signal coverage that is away from the noise of other IT infrastructure equipment.

  Or

- Keep the ES440 local to the IT infrastructure, place the antennas in an area with good signal coverage away from the noise of other electronic equipment, and cable the antennas to the ES440,

If you are experiencing RF performance throughput issues and you do not have the equipment to perform an RF site survey to determine the best location, your Sierra Wireless authorized distributor may have the tools and knowledge to help.

For simple installations in good LTE coverage, an Ethernet-connected configuration PC running your favorite speed test application and ACEmanager to determine network signal strength, cell info, and signal quality will help narrow down some of the location options.

Mounting the ES440

Warning: *This ES440 is not intended for use close to the human body. Antennas should be at least 8 inches (20 cm) away from the operator.*

Mount the ES440 where:

- There is easy access to connect to the enterprise router and to the antennas (see Locating the ES440 on page 28.
- The front panel LEDs are easily visible
- There is adequate airflow
- It is kept free from direct exposure to the elements, such as sun, rain, dust, etc.

The ES440 has four mounting holes to attach the ES440 to a mounting surface. These holes are accessible from the top of the device and screws are provided for mounting.

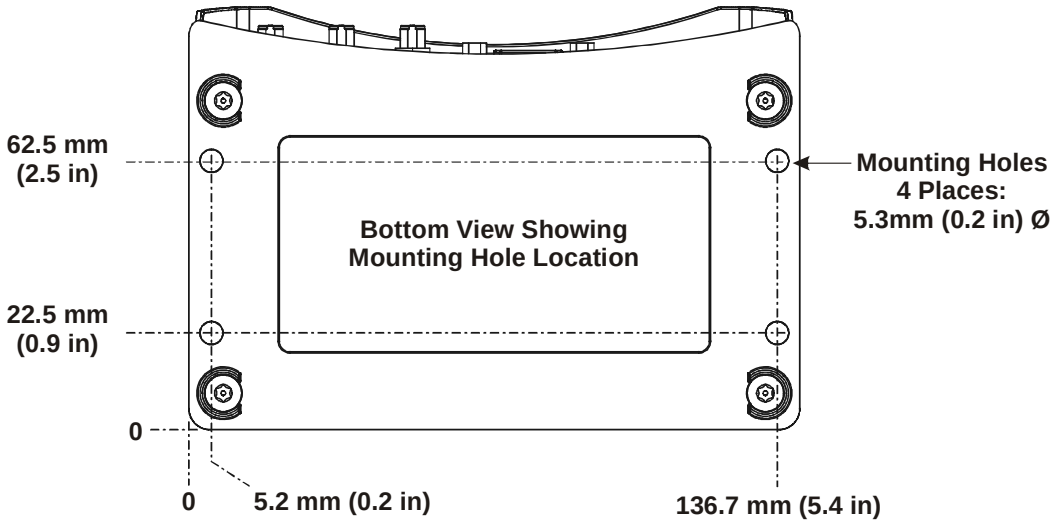


Figure 3-2: ES440 Bottom Plate and Mounting Hole Dimensions

Antenna Installation

If the location chosen in Locating the ES440 on page 28 is such that the antennas can connect directly to the ES440, then follow the instructions in Connecting the Antennas on page 17 to connect the antennas in a V-formation.

If you are cabling the antennas to the ES440, your Sierra Wireless authorized distributor may be able to assist with your cabling and installation.

The included antennas are for indoor use only.

If you want to use a third-party antenna placed outdoors Sierra wireless recommends working with your authorized distributor to provide the proper protection, which may include RF lightning arrestor and/or Ethernet surge suppressors. The antenna must be installed by qualified personnel. Note: Energy from a lightning strike spreads from DC to 1 GHz.

When placing either the included antennas or third-party antennas, follow the antenna separation guidelines in Antenna Separation Recommendations on page 30 for optimum performance.

Antenna Separation Recommendations

Inadequate antenna separation between the primary and secondary antennas creates unwanted interference that can cause reduction in:

- Antenna efficiency
- Transmit power
- Receiver sensitivity
- Data throughput
- Radio front-end life span

Antenna separation recommendations:

- The antennas should be separated so that there is at least 10dB isolation over the entire operating frequency range.
- The separation should be at least 0.25 wavelength (preferably greater than 0.5 wavelength) of the lowest operating frequency.

Note: If the separation is less than 0.25 wavelength, increase it to at least 0.25 wavelength (preferably greater than 0.5 wavelength) of the lowest operating frequency.

- In confined spaces, a separation of 0.15 wavelength is possible, but this will result in reduced network coverage.
- The recommended separation is only an approximate value for monopole or dipole type antennas.

Sierra Wireless recommends the following antenna separation:

Table 3-1: Recommended Antenna Separation

Service	Frequency (Hz)	Wavelength (mm)	Best Separation (> mm)	Good Separation (>mm)	Reduced Service Separation (> mm)
4G LTE	700	428	214	107	64
4G LTE	800	375	187	94	56
4G LTE	900	333	167	83	50
4G LTE	1800	167	83	42	25
4G LTE	2100	143	71	36	21
4G LTE	2600	115	58	29	17
3G WCDMA HSPA	850	353	176	88	53
3G WCDMA HSPA	900	333	167	83	50
3G WCDMA HSPA	1900	158	79	39	24
3G WCDMA HSPA	2100	143	71	36	21

Table 3-1: Recommended Antenna Separation

Service	Frequency (Hz)	Wavelength (mm)	Best Separation (> mm)	Good Separation (>mm)	Reduced Service Separation (> mm)
3G CDMA/EV-DO	800	375	187	94	56
3G CDMA/EV-DO	1900	158	79	39	24
2G GSM/GPRS/EDGE	850	353	176	88	53
2G GSM/GPRS/EDGE	900	333	167	83	50
2G GSM/GPRS/EDGE	1800	167	83	42	25
2G GSM/GPRS/EDGE	1900	158	79	39	24

Table 3-2: Separation Examples for Carrier-Specific Bands

Service	Band	Carrier	Country	Min Frequency (Hz)	Wavelength (mm)	Best Separation (mm)	Good Separation (mm)	Reduced Service Separation (mm)
LTE	13	Verizon	US	746	401.8665657	201	100	60
LTE	17	AT&T	US	704	425.8415597	213	106	64
LTE	4	Bell/Rogers/Telus	Canada	1710	175.3172269	88	44	26

Connecting the Enterprise Router

See Connecting the Enterprise Router on page 18.

Local Management

When the Ethernet port is connected to the enterprise router, ACEmanager requires a USB connection to a management PC and ALEOS must be configured to support virtual Ethernet over the USB interface.

AT Commands can also be executed locally if the USB interface is configured as a virtual serial connection.

Remote Management

Once power is applied and the configuration template is setup, the ES440 can be remotely managed using one of three methods:

- ACEmanager—OTA connections to the device (One on one management)
  Refer to the ALEOS Software Configuration User Guide.
- AirVantage Management Service—One to many management service
  Refer to www.sierrawireless.com/en/productsandservices/AirVantage/Management_Service.aspx

- SNMP—SNMP trap reporting and MIB tree parsing

  Refer to the ALEOS Software Configuration User Guide for more information or go to www.sierrawireless.com/en/Support/Downloads.aspx for a soft copy.

Antenna Recommendations

Note: Do not remove the secondary antenna. It helps the ES440 achieve the maximum network coverage. The ES440 works without one installed, but with reduced network coverage.

Note: If the antennas are located far away from the ES440, keep the cables as short as possible to prevent the loss of antenna gain.

Warning: *The antenna should not exceed the maximum gain specified in Maximum Antenna Gain (Gain D'antenne Maximal) on page 41. In more complex installations (such as those requiring long lengths of cable and/or multiple connections), you must follow the maximum dBi gain guidelines specified by the radio communications regulations of the Federal Communications Commission (FCC) or Industry Canada or your country's regulatory body (if used outside the US). Also see Important Information for North American Users on Radiation Exposure on page 40 for more information.*

4: AirLink ES440 Specifications

4G LTE Technology

- Verizon 700MHz Band 13 LTE
  Sierra Wireless MC7750 Radio Module
  (fallback to 800/1900 MHz EV-DO)
- AT&T 700MHz Band 4 & 17 LTE
  Sierra Wireless MC7700 Radio Module
  (fallback to 850/1900/2100 MHz HSPA+)
- EU 800/900/1800/2100/2600 MHz LTE
  Sierra Wireless MC7710 Radio Module
  (fallback to 900/1800/1900MHz HSPA+)

Theoretical LTE rates:

- Download—100 Mbps
- Upload—50 Mbps

Mobile Network Operator and Regulatory Approvals

- Approved for deployment on Verizon Wireless, AT&T, CE (Europe) and PTCRB (North America)

Protocols

- Network: TCP/IP, UDP/IP, DNS
- Routing: NAT, Host Port Routing, DHCP, PPPoE, VLAN, VRRP, Reliable Static Route
- Applications: Telnet/SSH, Reverse Telnet, SMTP, SNMP, SNTP

VPN/Security

- IPsec, SSL, and GRE VPN client
- Up to 5 VPN tunnels
- IKE encryption
- Port forwarding and DMZ
- Port filtering
- Trusted IP
- MAC address filtering

Device Management

- AirVantage™ Management Service cloud-based device management application

- ACEManager™ device configuration utility

Environmental

- Operating temperature: 0°C to +40°C (32°F to +104°F)
- Storage temperature: -30°C to +70°C (-22°F to +158°F)

Table 4-1: Operational/Non-Operational Environmental Specifications

Category	Op / Non-op	Reference
Drop	Non-operational	MIL-STD-810F, Method 516.5D
Electrostatic Discharge	Operational	IEC 61000-4-2
Surface Abrasion	Non-operational	IEC 60068-2-70 Part 2, Test Xb
Relative Humidity	Non-operational	MIL-STD-810F, 507.4
IP Rating	Non-operational	IEC 60529 – IP20
Cargo Vibration	Non-operational	ISTA 2A 2001, test categories 1, 4, 5, & 6

Table 4-2: Environmental Specifications

Document Name	Specification
Free Fall Test	IEC 60068-2-2
Low Storage Temperature	IEC 60068-2-1
Thermal Shock	MIL-STD-810, Method 501.4, 502.4

Host Interfaces

- 10/100 Base-T RJ-45 Ethernet
- RS-232 Serial port (DCE, requires null modem for console connection)
- USB V2.0 Micro-B connector
- 2 SMA antenna connectors (Primary, Secondary)
- Active antenna support

Industry Certifications

- PTCRB
- FCC
- Industry Canada
- CE
- RoHS Compliant

Power Consumption

- 100–240 VAC, 50/60 Hz, 500mA
- Adapters for North and South America, Great Britain, Europe, Australian and New Zealand

Dimensions and Weight

- 142 mm x 98 mm x 40 mm
  (5.6 in. x 3.8 in. z 1.6 in.)
- 397 g (14 oz.)

SIM Card holder

- The SIM socket is a 6-pin socket operated at 1.8V/3.3V.
- This interface is compliant with the applicable 3GPP standards for USIM.

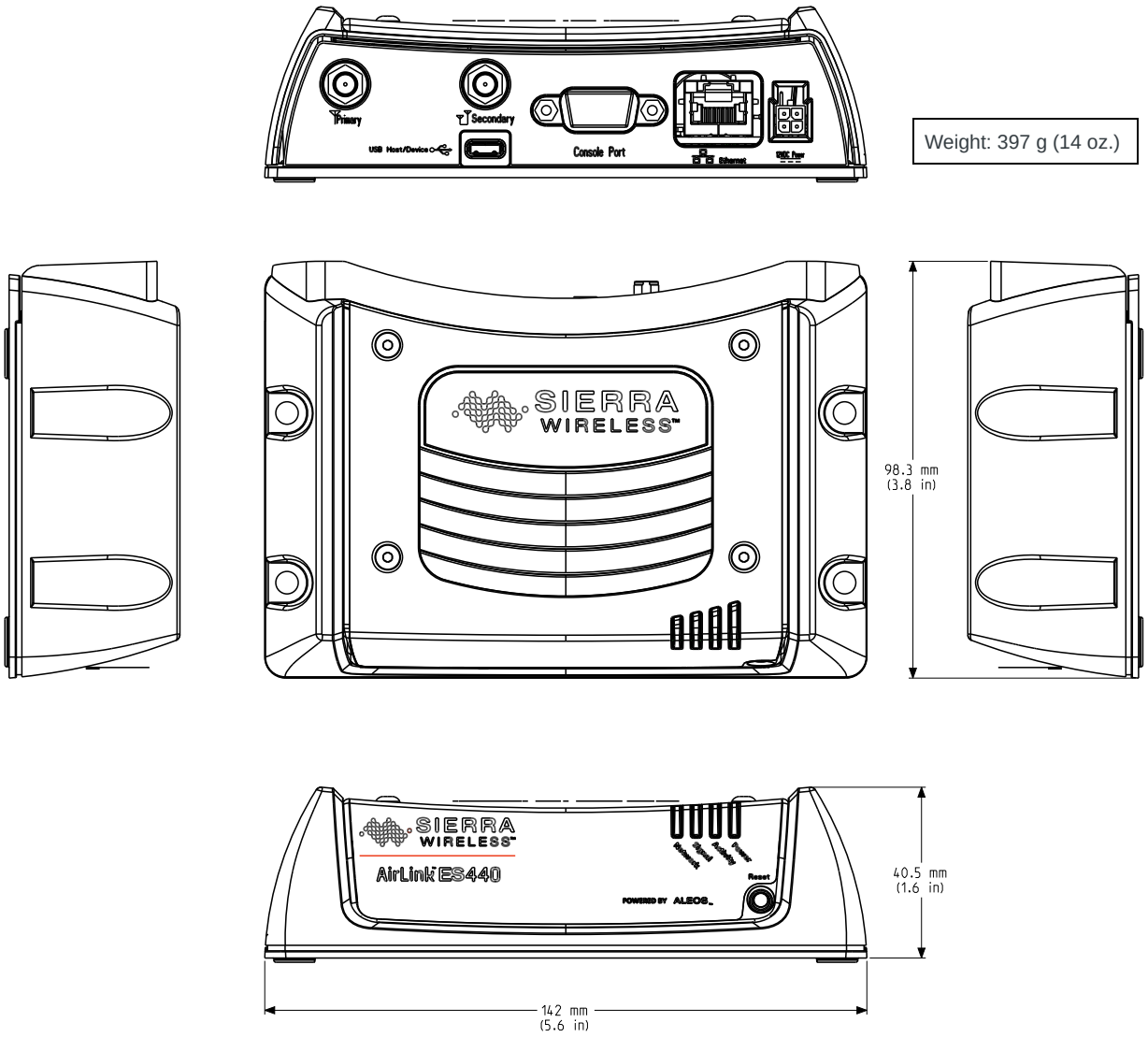
Construction Materials

The ES440 case is die cast using aluminum alloy A380, which is powder coated white.

RoHS

The ES440 complies with the Restriction of Hazardous Substances Directive (RoHS). This directive restricts the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment.

Mechanical Specifications



Weight: 397 g (14 oz.)

Figure 4-1: AirLink ES440 Mechanical Specifications

Regulatory Standards

- 47 CFR - Parts 2, 15, 22, 24
- Industry Canada RSS-132
- Industry Canada RSS-133
- R&TTE Directive 1999/5/EC
  - EMC standards
    - EN 301 489-1
    - EN 301 489-7
    - EN 301 489-24
  - Radio Spectrum standards

    - EN 301 908-1
    - EN 301 908-2
    - EN 301 511
  - Safety
    - IEC 60950-1:2005 (2nd Edition); Am 1:2009
    - EN60950-1:2006 +All:2009
  - RoHS
- PTCRB

Radio Frequency Bands by Product

Table 4-3: ES440 Verizon MC7750 Part Number 1101996

Radio Technology	Band	Frequencies
LTE	700 MHz LTE band 13 (Verizon)	Tx: 777 – 787 MHz Rx: 746 – 756 MHz
CDMA	800 MHz BC0 (US Cellular)	Tx: 824 – 849 MHz Rx: 869 – 894 MHz
	1900 MHz BC1 (US PCS)	Tx: 1850 – 1910 MHz Rx: 1930 – 1990 MHz

Table 4-4: ES440 MC7700 AT&T and Canada Part Number 1101997

Radio Technology	Band	Frequency
LTE	700 MHz LTE Band 17 (AT&T)	Tx: 704 – 716 MHz Rx: 734 – 746 MHz
	700 MHz LTE Band 4 (Canada)	Tx: 1710 – 1755 MHz Rx: 2110 – 2155 MHz
HSPA/ WCDMA / HSDPA/ HSUPA/ HSPA+/	Band I WCDMA 2100	Tx: 1920 – 1980 MHz Rx: 2110 – 2170 MHz
	Band II WCDMA 1900	Tx: 1850 – 1910 MHz Rx: 1930 – 1990 MHz
	Band V WCDMA 850	Tx: 824 – 849 MHz Rx: 869 – 894 MHz
	Band VIII WCDMA 900	Tx: 880 – 915 MHz Rx: 925 – 960 MHz

Table 4-4: ES440 MC7700 AT&T and Canada Part Number 1101997

Radio Technology	Band	Frequency
GSM/ GPRS/ EDGE	GSM 850	Tx: 824 – 849 MHz Rx: 869 – 894 MHz
	GSM 900	Tx: 880 – 915 MHz Rx: 925 – 960 MHz
	GSM 1800	Tx: 1710 – 1785 MHz Rx: 1805 – 1880 MHz
	GSM 1900	Tx: 1850 – 1910 MHz Rx: 1930 – 1990 MHz

Table 4-5: ES440 MC7710 Europe Part Number 1101998

Radio Technology	Band	Frequency
LTE	2100 MHz LTE Band 1	Tx: 1920 – 1980 MHz Rx: 2110 – 2170 MHz
	1800 MHz LTE Band 3	Tx: 1710 – 1785 MHz Rx: 1805 – 1880 MHz
	2600 MHz LTE Band 7	Tx: 2500 – 2570 MHz Rx: 2620 – 2690 MHz
	900 MHz LTE Band 8	Tx: 800 – 915 MHz Rx: 925 – 960 MHz
	800 MHz LTE Band 20	Tx: 832 – 862 MHz Rx: 791 – 821 MHz
HSPA/ WCDMA / HSDPA/ HSUPA/ HSPA+/ DC-HSPA	Band I WCDMA 2100	Tx: 1920 – 1980 MHz Rx: 2110 – 2170 MHz
	Band VIII WCDMA 900	Tx: 880 – 915 MHz Rx: 925 – 960 MHz
GSM/ GPRS/ EDGE	GSM 900	Tx: 880 – 915 MHz Rx: 925 – 960 MHz
	GSM 1800	Tx: 1710 – 1785 MHz Rx: 1805 – 1880 MHz
	GSM 1900	Tx: 1850 – 1910 MHz Rx: 1930 – 1990 MHz

5: Regulatory Information

Federal Communications Commission Notice (FCC United States)

Electronic devices, including computers and wireless devices, generate RF energy incidental to their intended function and are therefore subject to FCC rule and regulations. This equipment has been tested to, and found to be within the acceptable limits for a Class A digital device, pursuant to part 15 of the FCC Rules.

This equipment generates radio frequency energy and is designed for use in accordance with the manufacturer's user manual. However, there is no guarantee that interference will not occur in any particular installation.

If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off and on, you are encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

This device complies with Part 15 of the Federal Communications Commission (FCC) Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference.

Warning: *Changes or modifications to this device not expressly approved by Sierra Wireless could void the user's authority to operate this equipment.*

Notice for Canadian Users

This Class A digital apparatus complies with ICES-003.

Industry Canada Notice

This Class A device complies with ICES-003 and RSS-210 of the Industry Canada rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and

2. This device must accept any interference received, including interference that may cause undesired operation of the device.

Avis d'Industrie Canada

Cet appareillage numérique de la Classe A est conforme aux normes ICES-003 et RSS-210 du Canada. L'utilisation de ce dispositif est autorisée seulement aux conditions suivantes :

1. Il ne doit pas produire de brouillage et
2. Il doit accepter tout brouillage radioélectrique reçu, même si ce brouillage est susceptible de compromettre le fonctionnement du dispositif.

Important Information for North American Users on Radiation Exposure

This equipment complies with FCC/IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and the user's body.

Warning: *This product is only to be installed by qualified personnel.*

To comply with FCC/IC regulations limited both maximum RF output power and human exposure to RF radiation, maximum antenna gain must not exceed the values given in the tables in Maximum Antenna Gain (Gain D'antenne Maximal) on page 41.

Warning: *A minimum separation distance of 20 cm must be maintained between the antenna(s) used for this transmitter and all personnel.*

Informations Importantes Pour les Utilisateurs Nord-Américains sur L'exposition aux Radiations

Ce matériel est conforme aux limites établies par FCC/IC en matière d'exposition aux radiofréquences dans un environment non contrôlé. Ce matériel doit être installé et utilisé à une distance d'au moins 20 cm entrel'antenne et le corps de l'utilisateur.

Avertissement : *Ce produit est uniquement être installé par du personnel qualifié.*

Pour se conformer aux normes FCC/IC réglementation limitée à la fois la puissance maximale de sortie RF et l'exposition humaine aux rayonnements RF, gain d'antenne maximal ne doit pas dépasser les valeurs indiquées dans les tableaux de la section de gain d'antenne maximal.

Avertissement : *Une distance minimale de 20 cm doit être maintenue entre l'antenne (s) utilisées pour cet émetteur et l'ensemble du personnel.*

Maximum Antenna Gain (Gain D'antenne Maximal)

The antenna gain must not exceed the limits and configurations shown in the following tables:

Frequency Band	FCC ID / IC Number[a]			
	ES440 AT&T MC7700, Part Number 1101997 N7NMC7700/ 2417C-MC7700		ES440 Verizon MC7750 part number 1101996 N7NMC7750/ 2417C-MC7750	
	Standalone	Collocated	Standalone	Collocated
Cellular Band	7.5 dBi	5 dBi	7.5 dBi	5.5 dBi
PCS Band	3 dBi	3 dBi	3 dBi	3 dBi
LTE Band 4	5.5 dBi	5.5 dBi	N/A	
LTE Band 13	N/A		10.17 dBi	6.4 dBi
LTE Band 17	9 dBi	6 dBi	N/A	

a. The part number and description can be found on the label on the bottom of the ES440.

Europe Generic Devices

Sierra Wireless hereby declares the AirLink ES440 Europe MC7710 (part number 1101998) conforms to all the essential requirements of Directive 1999/5/EC.

Products are marked with a CE and notified body number and can be used throughout the European community. The alert symbol indicates that usage restrictions apply.

CE 0682

The AirLink ES440 is compliant with the RF exposure requirements at 20 cm separation distance specified in EN 62311:2008 and 1999/519/EC for mobile exposure conditions, provided the maximum antenna gain does not exceed the limits given in the table below.

Device	Frequency Band	Maximum Permitted Antenna Gain
Europe MC7710 (part number 1101998)	GSM 900	7.5 dBi
	GSM 1800	13.5 dBi
	WCDMA Band VIII	10.6 dBi
	WCDMA Band I	14.1 dBi
	LTE Band 1	15.2 dBi
	LTE Band 3	15.0 dBi
	LTE Band 7	16.2 dBi
	LTE Band 8	11.7 dBi
	LTE Band 20	10.2 dBi

Warning: *This product is only to be installed by qualified personnel.*

Warning: *A minimum separation distance of 20 cm must be maintained between the antenna(s) used for this transmitter and all personnel.*

6: Acronyms

Table F-1: Acronyms

Acronym or Term	Definition
1xEV-DO	Single Carrier (1X) EVolution—Data Only A high-speed standard for cellular packet data communications. It supports Internet connections with data rates up to 3.1 Mbps. (downlink from the network) and 1.8 Mbps (uplink to the network). Average data rates are roughly: for Rev. A: 600-1300 kbps. (downlink from the network) and 300-400 kbps (uplink to the network); for Rev. 0: 400-700 kbps (downlink from the network) and 40-80 kbps (uplink to the network). Actual speed depends on the network conditions. Compare to 1X.
1X	Single Carrier (1X) Radio Transmission Technology A high-speed standard for cellular packet data communications. It supports Internet connections with data rates up to 153 kbps (simultaneously in each direction—downlink and uplink). Actual speed depends on the network conditions. Compare to 1xEV-DO.
3GPP	3rd Generation Partnership Project
API	Application Programming Interface
AT	A set of device commands, preceded by “AT” originally developed by Hayes, Inc. for their devices. The structure (but not the specific commands, which vary greatly from manufacturer to manufacturer) is a de facto device industry standard.
CDG	CDMA Development Group
CDMA	Code Division Multiple Access A wideband spread spectrum technique used in digital cellular, personal communications services, and other wireless networks. Wide channels (1.25 MHz) are obtained through spread spectrum transmissions, thus allowing many active users to share the same channel. Each user is assigned a unique digital code, which differentiates the individual conversations on the same channel.
cdmaOne	The IS-95 CDMA standard developed by QUALCOMM Inc.
CnS	Sierra Wireless proprietary Control and Status protocol interface

Table F-1: Acronyms (Continued)

Acronym or Term	Definition
DCE	Data Communications Equipment
EIA	Electronics Industry Association
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EU	European Union Organization of European countries
ERP	Effective Radiated Power
ESN	Electronic Serial Number The unique first-generation serial number assigned to the LS300 for use on the wireless network.Compare to MEID.
FCC	Federal Communications Commission The U.S. federal agency that is responsible for interstate and foreign communications. The FCC regulates commercial and private radio spectrum management, sets rates for communications services, determines standards for equipment, and controls broadcast licensing. Consult www.fcc.gov.
FW	Firmware Software stored in ROM or EEPROM; essential programs that remains even when the system is turned off. Firmware is easier to change than hardware but more permanent than software stored on disk.
GPS	Global Positioning System A system that uses a series of 24 satellites to provide navigational data.
HSPA	High Speed Packet Access An amalgamation of two mobile telephony protocols: High Speed Downlink Packet Access (HSDPA) and High Speed Uplink Packet Access (HSUPA). It extends and improves the performance of existing 3rd generation mobile telecommunication networks utilizing the WCDMA protocols.
HSPA+	Evolved HSPA (also called HSPA+) allows bit-rates to reach as high as 168 Mbit/s in the downlink and 22 Mbit/s in the uplink. An improved 3GPP standard.
IEC	International Electrotechnical Commission
IOTA	Internet Over The Air An automated feature, supported by some service providers, to perform account setup for you by making a connection to the CDMA network and using a secure Internet connection to download account parameters to your device.

Table F-1: Acronyms (Continued)

Acronym or Term	Definition
IS	Interim Standard After receiving industry consensus, the TIATIA/EIA forwards the standard to ANSI for approval.
kbps	Kilobits per second Actually 1000, not 1024, as used in computer memory size measurements of kilobytes.
LED	Light Emitting Diode A semiconductor diode that emits visible or infrared light.
LTE	Long Term Evolution High performance air interface for cellular mobile communication systems.
Mbps	Millions of bits per second, or Megabits per second.
MEID	Mobile Equipment IDentifier The unique second-generation serial number assigned to the device for use on the wireless network. Compare to ESN.
NAM	Number Assignment Module Semi-permanent information stored in the device's non-volatile memory, including the device's Mobile Identification Number, the station class mark, carrier code, and other cellular identifiers. Essentially the phone number, it should be treated as confidential information and should not be disclosed to anyone other than the cellular service provider.
NV	Non-Volatile (memory)
OEM	Original Equipment Manufacturer A company that manufactures a product and sells it to a reseller.
OTAPA	Over the Air Parameter Administration
OTASP	Over the Air Service Provisioning
PCS	Personal Communications Services A cellular communication infrastructure that uses a different frequency range than AMPS.
PPP	Point to Point Protocol. An alternative communications protocol used between computers, or between computers and routers on the Internet. PPP is an enhanced SLIP.
PRI	Product Release Instructions A file containing the settings used to configure devices for a particular service provider, customer, or purpose.

Table F-1: Acronyms (Continued)

Acronym or Term	Definition
RF	Radio Frequency
RoHS	Restriction of use of Hazardous substances. EU Directive 2002/95
Rx	Receive
SKU	Stock Keeping Unit Identifies an inventory item: a unique code, consisting of numbers or letters and numbers, assigned to a product by a retailer for purposes of identification and inventory control.
SMS	Short Message Service A feature that allows users of a wireless device on a wireless network to receive or transmit short electronic alphanumeric messages (up to 160 characters, depending on the service provider).
TIA/EIA	Telecommunications Industry Association / Electronics Industry Association A standards setting trade organization, whose members provide communications and information technology products, systems, distribution services and professional services in the United States and around the world. Consult www.tiaonline.org.
Tx	Transmit
USB	Universal Serial Bus

Index

A

Acronyms, 43
Agency standards, 36
AirVantage, AVMS, 12
ALEOS
    default user name and password, 20
    description of, 11
Antenna
    , 10
    auxiliary receive port, 10
    Diversity/AUX, 10
    maximum gain, 10
    receive and transmit port, 10
    separation, 30
antenna, safe mounting, 28
AUX/Diversity antenna connector, 10
AVMS, 12

C

Case, composition of, 35
Cloud computing with AVMS, 12
Communication
    AirVantage, 12
    command line prompt, using, 21
    Ethernet connector, 10
    virtual Ethernet/serial port via USB, 11
Configuring with
    AirVantage, 24

D

Default
    settings for device, reset to, 9
Diversity/AUX Antenna Connector, 10

E

Ethernet
    computer connection and log in, 20
    connector, 10
Ethernet connector, 10

G

Glossary, 43

I

Installing SIM card, 15
IP address
    obtaining with command line prompt, 21

L

LED
    also see specific LED, 9
    description of LED, 21

P

Pinging device with command line prompt, 21

R

Receive port, backup, 10
Regulatory specifications, 36
Reset button, 9
RoHS compliance, 35
RS-232 port
    on rear panel, 10

S

Serial port
    RS-232, 10
SIM card
    installing, 15
Specifications
    regulatory, 36
Standards, regulatory, 36

U

USB port
    on front panel, 10

V

Virtual Ethernet port, 11

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